

The Formwork Experts.

Concremote

User Information

Instructions for assembly and use (Method statement)



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Elementary safety warnings

User target groups

- This manual is aimed at all persons who will be working with the Doka product or system that it describes. It contains information on the standard design for setting up this system, and on correct, compliant utilisation of the system.
- All persons working with the product described herein must be familiar with the contents of this manual and with all the safety instructions it contains.
- Persons who are incapable of reading and understanding this booklet, or who can do so only with difficulty, must be instructed and trained by the customer.
- The customer is to ensure that the information materials provided by Doka (e.g. User Information booklets, Instructions for Assembly and Use, Operating Instruction manuals, plans etc.) are available to all users, and that they have been made aware of them and have easy access to them at the usage location.
- In the relevant technical documentation and formwork utilisation plans, Doka shows the workplace safety precautions that are necessary in order to use the Doka products safely in the usage situations shown.
In all cases, users are obliged to ensure compliance with national laws, Standards and rules throughout the entire project and to take appropriate additional or alternative workplace safety precautions where necessary.

Hazard assessment

- The customer is responsible for drawing up, documenting, implementing and continually updating a hazard assessment at every job-site.
This document serves as the basis for the site-specific hazard assessment, and for the instructions given to users on how to prepare and utilise the system. It does not substitute for these, however.

Remarks on this document

- This manual can also be used as a generic method statement or incorporated with a site-specific method statement.
- **Many of the illustrations in this booklet show the situation during formwork assembly and are therefore not always complete from the safety point of view.**
Any safety accessories not shown in these illustrations must still be used by the customer, in accordance with the applicable rules and regulations.
- **Further safety instructions, especially warnings, will be found in the individual sections of this document!**

Planning

- Provide safe workplaces for those using the formwork (e.g. for when it is being erected/dismantled, modified or repositioned etc). It must be possible to get to and from these workplaces via safe access routes!
- **If you are considering any deviation from the details and instructions given in this booklet, or any application which goes beyond those described in the booklet, then revised static calculations must be produced for checking, as well as supplementary assembly instructions.**

Regulations; industrial safety

- All laws, Standards, industrial safety regulations and other safety rules applying to the utilisation of our products in the country and/or region in which you are operating must be observed at all times.
- If a person or object falls against, or into, the side-guard component and/or any of its accessories, the component affected may only continue in use after it has been inspected and passed by an expert.

Rules applying during all phases of the assignment

- The customer must ensure that this product is erected and dismantled, reset and generally used for its intended purpose in accordance with the applicable laws, Standards and rules, under the direction and supervision of suitably skilled persons. These persons' mental and physical capacity must not in any way be impaired by alcohol, medicines or drugs.
- Doka products are technical working appliances which are intended for industrial/commercial use only, always in accordance with the respective Doka User Information booklets or other technical documentation authored by Doka.
- The stability of all components and units must be ensured during all phases of the construction work!
- The functional/technical instructions, safety warnings and loading data must all be strictly observed and complied with. Failure to do so can cause accidents and severe (even life-threatening) damage to health, as well as very great material damage.
- Fire-sources are not permitted anywhere near the formwork. Heating appliances are only allowed if properly and expertly used, and set up a safe distance away from the formwork.
- The work must take account of the weather conditions (e.g. risk of slippage). In extreme weather, steps must be taken in good time to safeguard the equipment, and the immediate vicinity of the equipment, and to protect employees.
- All connections must be checked regularly to ensure that they still fit properly and are functioning correctly.
It is very important to check all screw-type connections and wedge-clamped joints whenever the construction operations require (particularly after exceptional events such as storms), and to tighten them if necessary.
- It is strictly forbidden to weld Doka products – in particular anchoring/tying components, suspension components, connector components and castings etc. – or otherwise subject them to heating. Welding causes serious change in the microstructure of the materials from which these components are made. This leads to a dramatic drop in the failure load, representing a very great risk to safety.
The only articles which are allowed to be welded are those for which the Doka literature expressly points out that welding is permitted.

Assembly

- The equipment/system must be inspected by the customer before use, to ensure that it is in suitable condition. Steps must be taken to rule out the use of any components that are damaged, deformed, or weakened due to wear, corrosion or rot.
- Combining our formwork systems with those of other manufacturers could be dangerous, risking damage to both health and property. If you intend to combine different systems, please contact Doka for advice first.
- The equipment/system must be assembled and erected in accordance with the applicable laws, Standards and rules by suitably skilled personnel of the customer's, having regard to any and all required safety inspections.
- It is not permitted to modify Doka products; any such modifications constitute a safety risk.

Closing the formwork

- Doka products and systems must be set up so that all loads acting upon them are safely transferred!

Pouring

- Do not exceed the permitted fresh-concrete pressures. Over-high pouring rates overload the formwork, cause greater deflection and risk breakage.

Stripping out the formwork

- Do not strip out the formwork until the concrete has reached sufficient strength and the person in charge has given the order for the formwork to be stripped out!
- When stripping out the formwork, never use the crane to break concrete cohesion. Use suitable tools such as timber wedges, special pry-bars or system features such as Framax stripping corners.
- When stripping out the formwork, do not endanger the stability of any part of the structure, or of any scaffolding, platforms or formwork that is still in place!

Transporting, stacking and storing

- Observe all regulations applying to the handling of formwork and scaffolding. In addition, the Doka slinging means must be used - this is a mandatory requirement.
- Remove any loose parts or fix them in place so that they cannot be dislodged or fall free!
- All components must be stored safely, following all the special Doka instructions given in the relevant sections of this manual!

Maintenance

- Only original Doka components may be used as spare parts. Repairs may only be carried out by the manufacturer or authorised facilities.

Miscellaneous

We reserve the right to make alterations in the interests of technical progress.

Symbols used

The following symbols are used in this booklet:



Important note

Failure to observe this may lead to malfunction or damage.



CAUTION / WARNING / DANGER

Failure to observe this may lead to material damage, and to injury to health which may range up to the severe or even life-threatening.



Instruction

This symbol indicates that actions need to be taken by the user.



Sight-check

Indicates that you need to do a sight-check to make sure that necessary actions have been carried out.



Tip

Points out useful practical tips.



Reference

Refers to other documents and materials.

Eurocodes at Doka

In Europe, a uniform series of Standards known as **Eurocodes** (EC) was developed for the construction field by the end of 2007. These are intended to provide a uniform basis, valid throughout Europe, for product specifications, tenders and mathematical verification. The EC are the world's most highly developed Standards in the construction field.

In the Doka Group, the EC are to be used as standard from the end of 2008. They will thus supersede the DIN norms as the "Doka standard" for product design.

The widely used "Permissible stress design" (comparing the actual stresses with the permissible stresses) has been superseded by a new safety concept in the EC.

The EC contrast the actions (loads) with the resistance (capacity). The previous safety factor in the permissible stresses is now divided into several partial factors. The safety level remains the same!

$$E_d \leq R_d$$

E_d **Design value of effect of actions**

(E ... effect; d ... design)
Internal forces from action F_d
(V_{Ed}, N_{Ed}, M_{Ed})

F_d **Design value of an action**

$F_d = \gamma_F \cdot F_k$
(F ... force)

F_k **Characteristic value of an action**

"actual load", service load
(k ... characteristic)
e.g. dead weight, live load, concrete pressure, wind

γ_F **Partial factor for actions**

(in terms of load; F ... force)
e.g. for dead weight, live load, concrete pressure, wind
Values from EN 12812

R_d **Design value of the resistance**

(R ... resistance; d ... design)
Design capacity of cross-section
(V_{Rd}, N_{Rd}, M_{Rd})

Steel: $R_d = \frac{R_k}{\gamma_M}$ Timber: $R_d = k_{mod} \cdot \frac{R_k}{\gamma_M}$

R_k **Characteristic value of the resistance**

e.g. moment resistance to yield stress

γ_M **Partial factor for a material property**

(in terms of material; M...material)
e.g. for steel or timber
Values from EN 12812

k_{mod} **Modification factor** (only for timber – to take account of the moisture and the duration of load action)
e.g. for Doka beam H20
Values as given in EN 1995-1-1 and EN 13377

Comparison of the safety concepts (example)

Permissible stress design	EC/DIN concept
<p>$F_{actual} \leq F_{permissible}$</p>	<p>$E_d \leq R_d$</p>
A Utilisation factor	



The "permissible values" communicated in Doka documents (e.g.: Q_{permissible} = 70 kN) do not correspond to the design values (e.g.: V_{Rd} = 105 kN)!

- Avoid any confusion between the two!
- Our documents will continue to state the permissible values.

Allowance has been made for the following partial factors:

γ_F = 1.5

γ_{M, timber} = 1.3

γ_{M, steel} = 1.1

k_{mod} = 0.9

In this way, all the design values needed in an EC design calculation can be ascertained from the permissible values.

Doka services

Support in every stage of the project

Doka offers a broad spectrum of services, all with a single aim: to help you succeed on the site.

Every project is unique. Nevertheless, there is one thing that all construction projects have in common – and that is a basic structure with five stages. We at Doka know our clients' varying requirements. With our consulting, planning and other services, we help you achieve effective implementation of your formwork assignment using our formwork products – in every one of these stages.



Project Development Stage



Taking well-founded decisions thanks to professional advice and consulting

Find precisely the right formwork solutions, with the aid of

- help with the bid invitation
- in-depth analysis of the initial situation
- objective evaluation of the planning, execution, and time-risks



Bidding Stage



Optimising the preliminary work with Doka as an experienced partner

Draw up potentially winning bids, by

- basing them on realistically calculated guideline prices
- making the right formwork choices
- having an optimum time-calculation basis



Project Management Planning Stage



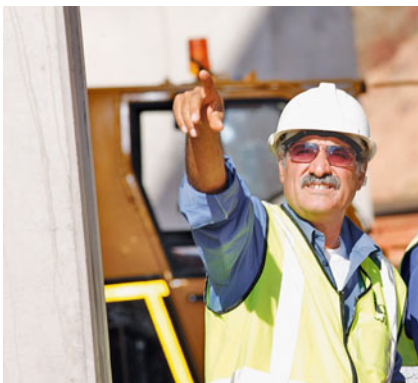
Controlled, regular forming operations, for greater efficiency resulting from realistically calculated formwork concepts

Plan cost-effectively right from the outset, thanks to

- detailed offers
- determination of the commissioning quantities
- co-ordination of lead-times and handover deadlines



Concrete Construction Stage



Optimum resource utilisation
with assistance from the Doka
Formwork Experts

Workflow optimisation, thanks to

- thorough utilisation planning
- internationally experienced project technicians
- appropriate transport logistics
- on-site support



Project Close-out Stage



Seeing things through to a positive conclusion
with professional support

Doka Services are a byword for transparency and efficiency here, offering

- jointly handled return of rented formwork
- professional dismantling
- efficient cleaning and reconditioning using special equipment

The advantages for you
thanks to professional advice and consulting

▪ **Cost savings and time gains**

When we advise and support you right from the word "go", we can make sure that the right formwork systems are chosen and then used as planned. This lets you achieve optimum utilisation of the formwork equipment, and effective forming operations because your workflows will be correct.

▪ **Maximised workplace safety**

The advice and support we can give you in how to use the equipment correctly, and as planned, leads to greater safety on the job.

▪ **Transparency**

Because our services and costs are completely transparent, there is no need for improvisation during the project – and no unpleasant surprises at the end of it.

▪ **Reduced close-out costs**

Our professional advice on the selection, quality and correct use of the equipment helps you avoid damage, and minimise wear-and-tear.

System description

Concrete monitoring: how it works, how it is used

Measuring concrete strength in real time.

Concremote is a service for performing non-destructive real-time measurement of concrete strengths in structure members (floor-slabs, walls, beams, ...) on the site.

This service comprises two parts:

- measuring-sensors
- data management and processing

The **sensors** placed on the structure member continuously measure the heat development of the concrete, which is mainly influenced by the hydration heat of the cement and by ambient temperatures. The more intense the heat development, the faster the strength development of the concrete.

The **measured data** (temperature measurements) from the structure member are transmitted to the computing centre via the mobile communications network as data packets. At the computing centre, they are automatically evaluated by the maturity monitoring method, using calibration measurement.

A separate calibration measurement is needed for each different grade of concrete to be measured at the site. This calibration measurement must be performed either by the clients themselves, by the concrete supplier or by an appointed test laboratory – ideally, using the calibration box. For this purpose, six cubes are stored under defined partially adiabatic conditions. The cubes are tested at different times, depending on the target value (in N/mm² / MPa, for stripping, curing, etc.). Each of these tests yields a compressive strength value, and the temperature value associated with it. From this calibration measurement, the relationship can be computed between the strength and the maturity of the grade of concrete concerned.

The Concremote software continuously provides these data and strengths to its users, enabling them to live monitor the strength development in a specific structure member.

As soon as the target value (in N/mm² / MPa) is reached, the next steps (stripping, pre-stressing, etc.) can be taken.

Precise measurement facilitates accurate control

Efficient construction processes

The strength values computed by Concremote, according to the maturity method by de Vree, permit targeted control of forming and concreting operations in real time.

Concremote provides very accurate results on the basis of reference values, which in turn are based on the cube strengths obtained from the calibration measurement.

It records profiles of both the concrete temperature and the ambient temperature around the sensors.

Highly versatile

2 types of sensor

The Concremote **slab sensor** and the Concremote **cable sensor** can be used in a targeted manner in all areas of cast-in-place building construction.

- Cast-in-place concrete floor-slabs
- Wall and column formwork
- Crane-climbed and automatic climbing projects
- Bridge and tunnel building sites
- Mass concrete structures

Easy to use

Wireless data transmission and easy access from anywhere

The user-friendly software can be used effortlessly and can be accessed from any internet-enabled device at any time.

Certainty for the construction project

Helps you take decisions and records your data

- Compliant decision-making based on the measured data.
- Strength development can be estimated early on from graphs.
- Printing and storage of data for long-term verification.

Exact results enabled by calibration

The calibration box is used to calibrate the different grades of concrete used. These calibration measurements provide reference data for computing the compressive strength development in relation to the maturity.

Before the sensors are used, Concremote generates a calibration curve for each grade of concrete, by means of the calibration box.

The smallest measurable strength is 5 N/mm².

Online data access

Via the user-optimised, web-based programme, users can access the data at any time. Furthermore, they can grant read and write permissions.

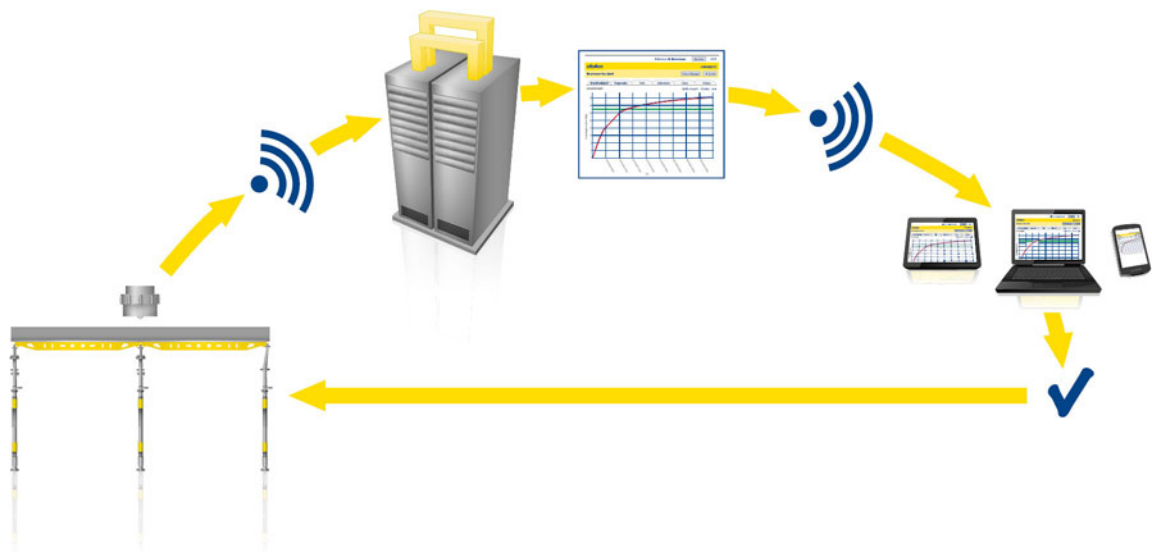
Users can store data and unlock them for use by authorised persons.

Accurate documentation ensures both certainty for the building process and transparency.



The temperature, maturity and strength data will help you take decisions in many areas:

- Stripping time
 - Crack width limitation (stresses)
 - Loads
 - Curing measures
 - Pre-stressing
 - Cycle times
 - Temporary reshores
 - Construction conditions
 - Concrete orders
 - Team coordination
- etc.



Process scheme

Concremote cable sensors in detail

- **Sensor for universal application**
 - Battery included with the sensor (battery life: approx. 4 months)
 - Cable with one or several measuring point(s)
 - Sensing element wall
- **Extremely flexible**
 - Measuring points inside the structure member can be chosen freely
 - Power supply by battery
 - Sturdy design for site use



Battery-saving storage:
Unplug the cable from the cable sensor.
The power supply to the sensor is turned off and the battery life will improve.



Concremote cable sensor accessories



	Concremote sensing element wall	Concremote cable, 3 sensors	Concremote cable, 1 sensor
Item			
Description	<ul style="list-style-type: none">▪ Designed for repeated measurement at the concrete surface▪ Reusable	<ul style="list-style-type: none">▪ 3 measuring points▪ Lengths: 8 m, 10 m and special lengths▪ Measuring points inside the concrete (e.g. fixed to reinforcement)▪ Non-reusable part	<ul style="list-style-type: none">▪ 1 measuring point▪ Lengths: 0.6 m, 1.5 m and special lengths▪ Measuring points inside the concrete (e.g. fixed to reinforcement)▪ Non-reusable part

Concremote slab sensors in detail



- **Sensor for horizontal concrete members**
 - Battery included with the sensor (battery life: approx. 4 months)
- **Extremely user-friendly**
 - For multiple use, with no 'lost' parts
 - Wireless
 - Power supply by battery
 - Easy to install – 'floats' on top of the concrete
 - Sturdy design for site use



Battery-saving storage:

Store the slab sensor with its tip pointing upwards.

The power supply to the sensor is turned off and the battery life will improve.

Concremote battery set (accessory)

The cable sensor and the slab sensor both come with a battery. The battery life is approx. 4 months.

For details on how to change the battery, please see the sections 'How to use slab sensors / cable sensors'.



Lithium-ion polymer battery < 100 kW

Concremote calibration box



Easy calibration of concrete

- Measuring device and cube mould included
- Use of standard cubes sized 15x15x15 cm
- 2 boxes (6 concrete cubes) are needed for calibration
- For multiple use, with no 'lost' parts



Important note:

- A fully charged storage battery lasts 4 weeks (charger is included with the calibration box).
- Ensure that connectivity of the calibration box is maintained at all times. The quality of the connection can be checked online.
- Calibration is performed either by the user himself or by someone appointed by the user. The support team provides assistance in this process.

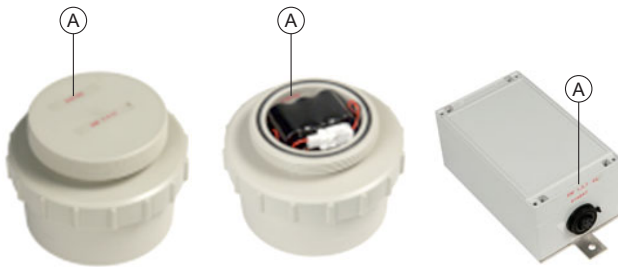
Handling

How to install and mount the sensors



Important note:

- Sensors and accessories must be installed and mounted from safe workplaces only.
- Do not treat the sensors with release agent.
- Do not apply force to the sensors when installing or removing them.
- Protect the sensors against theft and mechanical damage.
- Each sensor has its own serial number.



98084-000

A Serial number of the sensor



Important note:

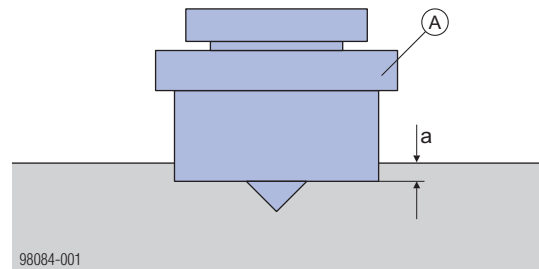
Check at regular intervals if all components work properly. Any technical problems must be reported to us immediately.

How to use Concremote slab sensors

Prior to installing the sensor for the first time, turn the top lid open and connect the battery by means of the white plug. Then close the lid again.



Immediately after pouring and levelling / trowelling the concrete, place the sensor on the concrete surface with its tip pointing downwards. The sensor may sink a few centimetres into the concrete, depending on the texture. There is no need to push the sensor down into the concrete. The insertion depth is sufficient when the sensor's tip is immersed in the concrete.



98084-001

a ... Immersion depth of between 1 and 3 cm, depending on the concrete texture

A Concremote slab sensor

How to use Concremote cable sensors

General

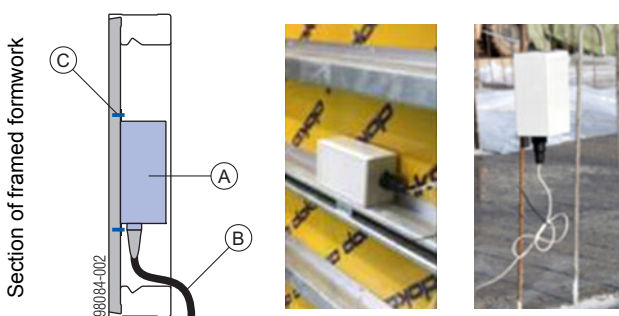
The cable sensor can be fixed in different positions, depending on the specific application:

- to the formwork
- to the projecting reinforcement

The cables are embedded in the concrete and are therefore non-reusable.

The sensor number is printed both on the lid and inside the battery compartment.

The cable can be installed in the structure member from above or below or can be inserted through the formwork.



- A** Concremote cable sensor
- B** Cable or sensing element wall
- C** Fixed twice with standard screws

Changing the battery

Open the housing with a screwdriver.

- Carefully remove the small side covers
- Unscrew the screws
- Change the battery
- Close the housing again



How to use Concremote cables

General

The cables can be used only in conjunction with the cable sensor.

Different kinds of cables with either one or three measuring point(s) are available, depending on the specific application.

All cables are non-reusable since they remain embedded in the concrete.

The cable length is chosen separately for each project. Special lengths are available if needed. (Longer delivery time!)



Make sure that the cables do not get damaged during concreting operations (e.g. by internal vibrators).



Measurement at exposed positions in the structure member may require an auxiliary construction to be fitted by the user (e.g. additional brackets).

Installation

- Determine the position of the cable sensor and fix the sensor properly.
- Connect the cable to the cable sensor by turning it (sensor starts data transmission).
- Fit the cable and fasten it to the reinforcement using cable ties.

Dismantling

- 1) Disconnect the cable from the cable sensor.
- 2) Cut the cable flush with the concrete surface.

How to use the Concremote sensing element wall

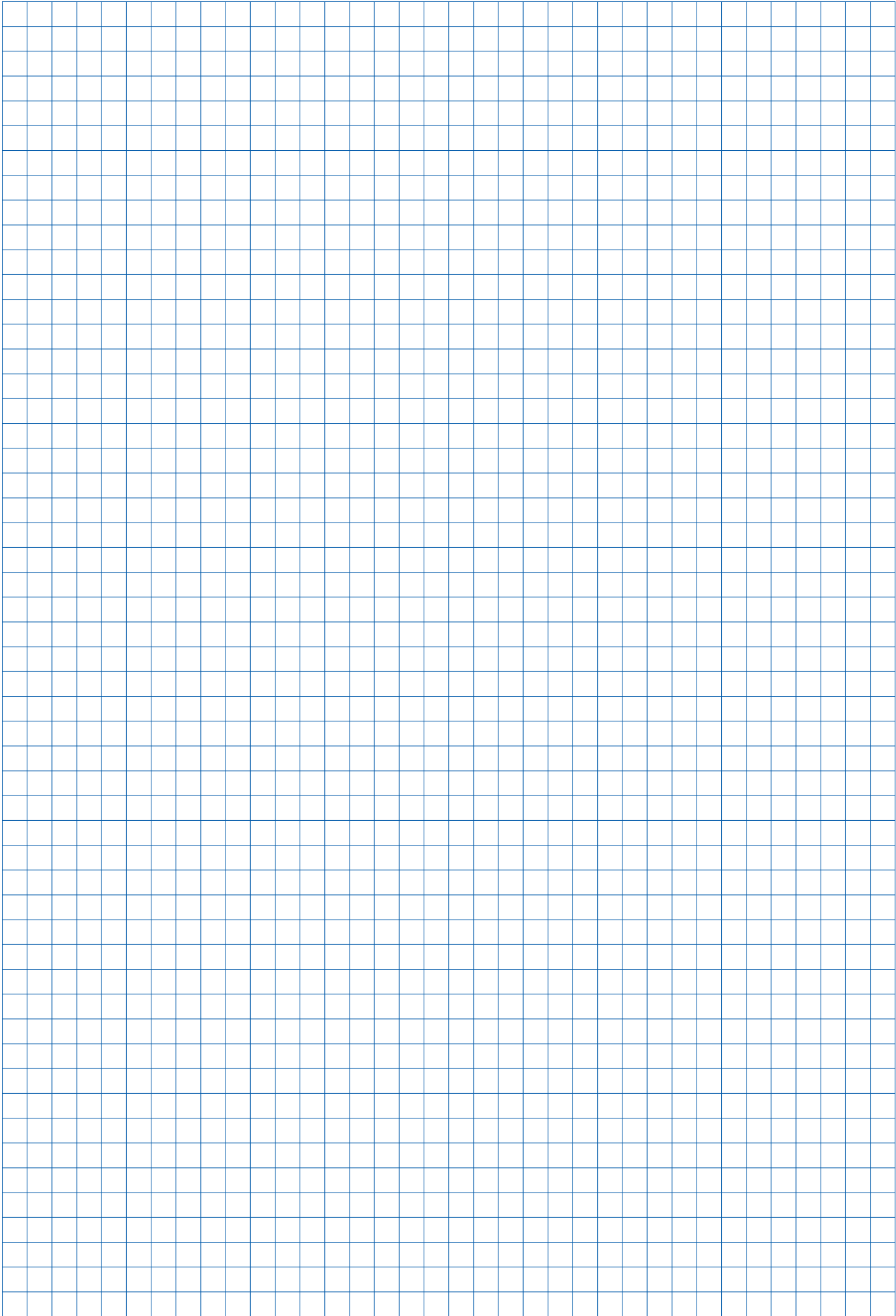
General

The sensing element wall is designed for multiple use, in conjunction with the cable sensor only.
Clean the measuring point after each use.



Installation

- Determine the position of the cable sensor and the measuring point and fix the sensor in place.
- Drill a hole, corresponding to the diameter of the sensing element, into the formwork sheeting at the measuring position.
- Connect the cable of the sensing element to the cable sensor by turning it (sensor starts data transmission).
- Fit the cable and fasten the sensing element to the formwork sheeting using three appropriate screws.



How to use the Concremote software (web portal)

The Concremote software is a data analysis system and serves as user interface for data input and output.

The sensors are activated in the Concremote software upon their delivery. The login data for the software is sent by e-mail.

The Concremote software does not require installation on your computer.

What to do in case of a sensor failure

Proper functioning of the sensors is dependent on the battery power, flawless network connectivity and smooth functioning of the software and hardware. If data transmission is interrupted, the registered users will be notified by e-mail.

Reasons for failure and what to do

Failure due to connectivity problems

In areas with a poor or with no network connection, a microwave link can be set up by the user.

If transmission temporarily fails, the sensor will store the measured data for a period of 24 hours, and transmit them once the connection is up again.



In some cases it may be sensible to remove the sensor from where it is installed, and to temporarily put it in a location with better connectivity for data transmission. After this, the sensor can be fitted back to the structure member.

Failure due to low battery power

With no battery power, the sensors do not save any data at all. Therefore, in case of a failure due to low battery power, the battery must be replaced as quickly as possible. If data transmission is interrupted for too long, the measurement may be lost.



It is therefore recommended to always store spare batteries at the building site.

Other failures

In case of a failure that is not due to connectivity problems or low battery power, resetting the sensor may solve the problem:

- Slab sensor: hold the sensor with its tip pointing upwards for 1 minute.
- Cable sensor: unplug the cable and leave it unplugged for 1 minute.

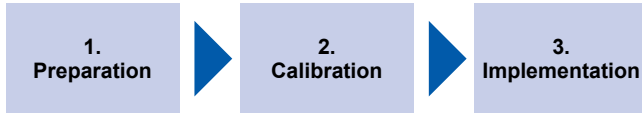
If the problem continues, please notify the support team.

Use

General use

Overview

The use of Concremote can be split into three stages:



Important note:

- Concremote in no way replaces the prescribed concrete tests.
- If you have any questions, please ask your Doka contact person!

Preparation

- Plan what the sensors will be used for (see the section 'Areas of use').
- Specify the target value in consultation with the structural engineer (for more detailed information see the section 'Reshoring props, concrete technology and striking').
- Decide on the calibration measurements to be made for the concrete mixtures used, and choose a test laboratory (see the 'Concremote calibration box' User Information booklet).
- Perform a function test (see the 'Concremote software' User Manual).

Calibration

Each different concrete mixture needs to be calibrated with the calibration box in order to be able to calculate its strength development, based on the temperature data measured by the sensors.

2 calibration boxes (with 3 concrete cubes each) are necessary for calibration.

Prior to using the sensors for the first time, a calibration measurement must be made for each concrete mixture to be measured with Concremote.

Calibration at a glance:

- The calibration boxes are filled with concrete either on the site or in the concrete mixing plant, depending on the project.
- The filled calibration boxes must be transported to the test laboratory either within 2 hours, or after between 18 and 24 hours, to ensure that the hardening process is not affected.
- The six cubes are tested at prescribed intervals.



After completing all of the six compressive strength tests, the software will automatically generate the calibration curve for the concrete that has been tested. The corresponding data can be accessed via the Concremote software.

For more detailed information, please refer to the User Information booklet supplied with the calibration box.

Implementation

Performing a measurement involves two steps:

- Positioning the sensor in the structure member
- Adding the measurement in the software



Important note:

In some special cases, calibration and installation of the sensors can be done at the same time. Please ask your Doka contact person if you have any questions regarding this!

Positioning the sensor in the structure member

- Position the sensor in the structure member and make sure it does not disrupt any further building processes or subsequent work steps (e.g. travelling of tables, mounting of plumbing accessories, the projecting reinforcement, etc.).



- Record a name for the structure member in question (e.g. Floor-slab above GF house 1), the installation time and the sensor's serial number. These data will be entered in the software later.

Adding the measurement in the Concremote software

- For adding a new structure member or new measurement in the software, start the 'Project Manager'.
- Sensors are assigned to a structure member by means of their sensor number and the recorded installation time.

Analysis

The measured data is automatically analysed.

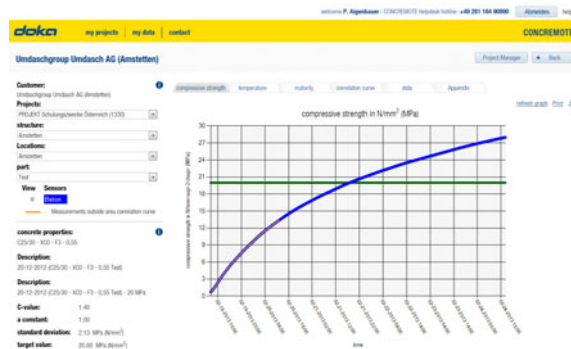
Users can access various graphs (time-compressive strength chart, time-temperature chart) and view data in list form.

The measurement results can be printed and exported.

Data analysis

General

The web-based programme is supported by most internet-enabled devices and can be accessed from your browser at concremote.doka.com.



Use

- ▶ Log in at concremote.doka.com by entering the login data you have received by e-mail
- ▶ Start the Project Manager and add a measurement
- ▶ Add the structure members (e.g. Member A)
- ▶ Add the measurements (e.g. Floor-slab GF)
- ▶ Assign the sensors (sensor / date / installation time)
- ▶ Read the data



Important note:

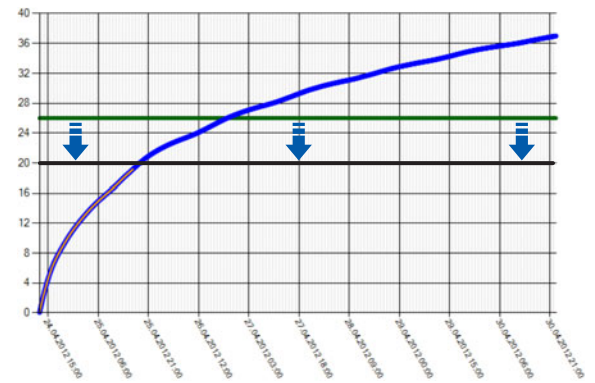
If a battery fails, data will be lost. In case of a transmission error, the measured data will be stored for a minimum of 24 hours.

Remedies

Concremote shows the strength development of a specific, previously calibrated concrete mixture in the area surrounding the sensors.

1. Optimising the target value

The compressive strength target value should be optimised in consultation with the structural engineer / designer. For assistance, please refer to the section 'Reshoring props, concrete technology and striking'.



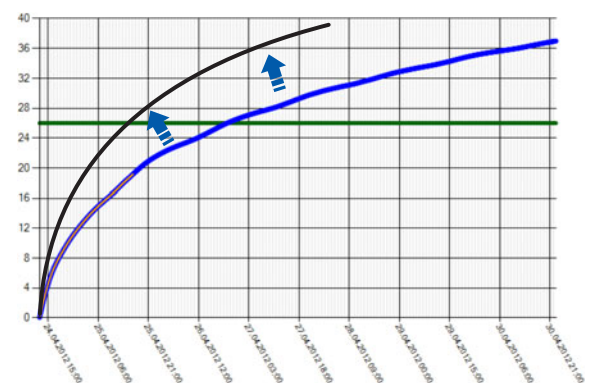
2. Improving strength developments

Optimising the concrete mixture

- Increase of the fresh concrete temperature in mixing (heating of aggregates and/or of mixing water)
- Modification of the binder and/or cement
- Modification regarding chemical and mineral admixtures

Preventing heat loss of the structure member

- By covering the structure member with sheeting or insulation
- By means of enclosures and/or by heating the member



Important note:

All of these measures must comply with the relevant Standards and rules, and may be taken only after consultation with the concrete supplier and the structural engineer / designer.



Find detailed information and support to assist you with the software at www.doka.com!

Areas of use

Concremote is non-formwork dependent and can be used in any kind of structural concrete element.

For each structural element and cycle, a minimum of 2 sensors is required.

The information given herein must be observed at all times depending on the specific area of use.

The installation points are determined separately for each project. The examples given in this section are to be considered as possible applications of Concremote. The advice of the structural engineer should be sought for determining those points that are critical in terms of static requirements. The sensors must be positioned in such a way that they measure the most critical (maximum stress) or most unfavourable points with regard to the strength development. If necessary, protect the sensors from factors such as sunlight, radiant heaters, etc.



WARNING

- The Concremote system must be handled and used correctly in order for it to function properly. Non-compliance with the information provided herein may lead to accidents.

Floor-slabs

In floor-slabs, the use of slab sensors is recommended. Cable sensors can be used as an alternative.

The slab sensors are positioned after levelling / trowelling the floor-slab.



Number of sensors in a floor-slab cycle:

- up to 500 m²: at least 2 sensors
- more than 500 m²: more than 2 sensors, as required

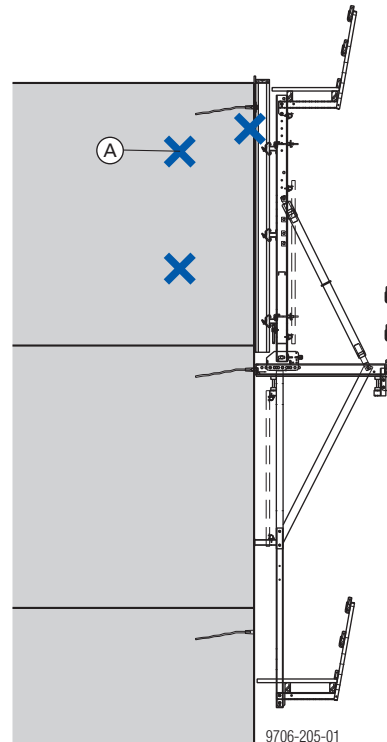
Mass concrete structures

Cable sensors are recommended for recording the heat development in mass concrete structures.

The measuring points of the cables can be chosen freely (cables are fixed to the reinforcement using cable ties).

Fix the measuring points (blue marks on the cable) at an adequate distance from the reinforcement in order to prevent the temperature of the reinforcement from affecting the concrete measurement.

For performing measurements at any desired position in the concrete, an auxiliary, single-use construction may have to be fitted by the user (e.g. reinforced steel).



A Cable positions

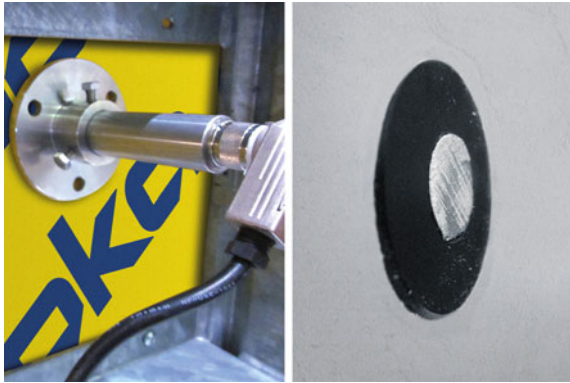
Climbing formwork

In the area of suspension points

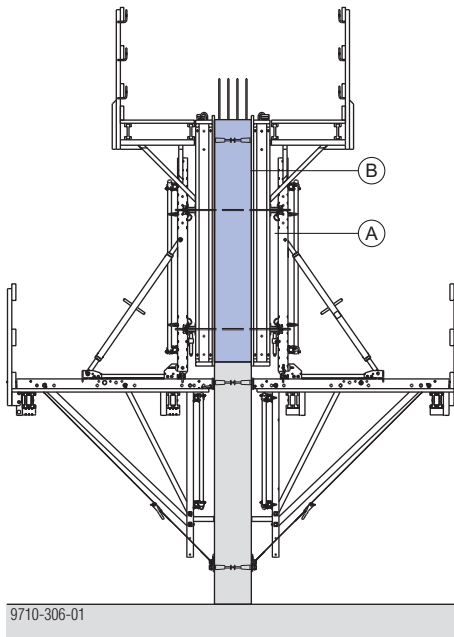
In order for a climbing formwork suspension point to provide sufficient load-bearing capacity, the concrete must have sufficient strength.

With Concremote, the strength development of the concrete can be displayed easily and in a verifiable manner.

For measuring the strength development at a suspension point, use the cable sensor in conjunction with the sensing element wall.



For measuring core temperatures, the cable sensor in conjunction with a measuring cable with 3 measuring points is best suited.



Example: climbing cycle

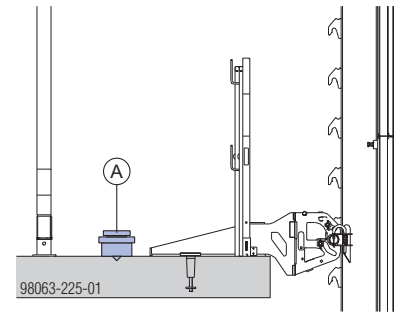
A Cable sensor installed in the wall formwork

B Sensing element wall

At least 2 measuring positions are required for each climbing cycle.

For protection screens

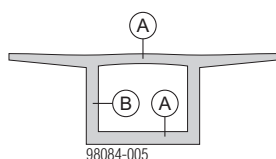
Slab sensors can be used to determine the concrete strength in the area of suspension points.



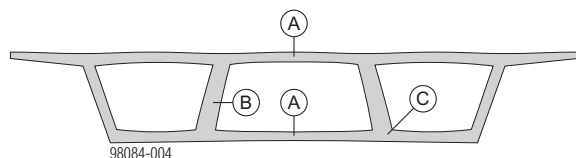
A Slab sensor

Bridge formwork

Cross sections through bridges



Example: single-celled bridge cross section



Example: three-celled bridge cross section

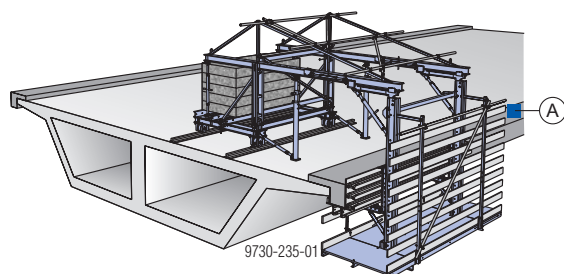
- A** Slab sensor
- B** Sensing element wall
- C** Measuring point of the cable

For cycles of up to 10 linear metres in length, measure the critical points in at least two cross-sectional planes. Further sensors are recommended to be used every additional 5 linear metres.

Bridge edge beams

Slab sensors can be used in the manufacture of edge beams. For up to 15 linear metres, 2 sensors are necessary.

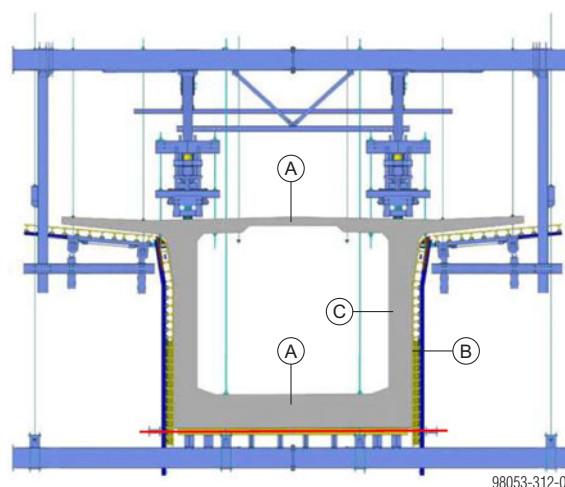
Further sensors are recommended to be used every additional 10 linear metres.



- A** Slab sensor

Free cantilever construction

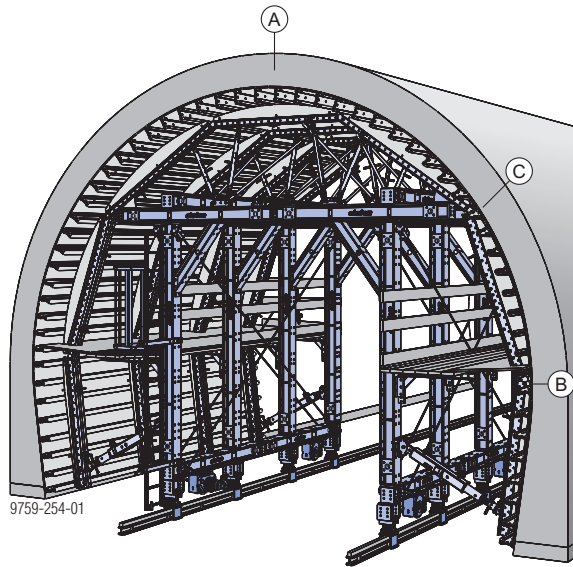
Concremote helps you determine the earliest possible time of pre-stressing the concrete or of stripping the cantilever forming traveller.



- A** Slab sensor (floor-slab / roadway slab)
- B** Sensing element wall (walls)
- C** Measuring point of the cable (walls)

Tunnel formwork

In tunnel forming, Concremote is used for determining early concrete strengths as well as to ensure sufficient strength of the concrete in the bottom slab for the ground anchors.



- A** Slab sensor
- B** Sensing element wall
- C** Measuring point of the cable



Important note:

The smallest compressive concrete strength that can be measured using Concremote is 5 N/mm².

For bored tunnelling, check in advance whether network connectivity is available since the sensors transmit data via GSM.

Other areas of use

- Pre-stressing
- Monolithic concrete tanks
- Temperature measurement
- Post-pouring work
- Road construction
 - Saw cutting
- Hall floors

Transporting, stacking and storing

The following instructions must be complied with when storing and transporting separate parts or assemblies. This ensures careful, safe treatment of the equipment:

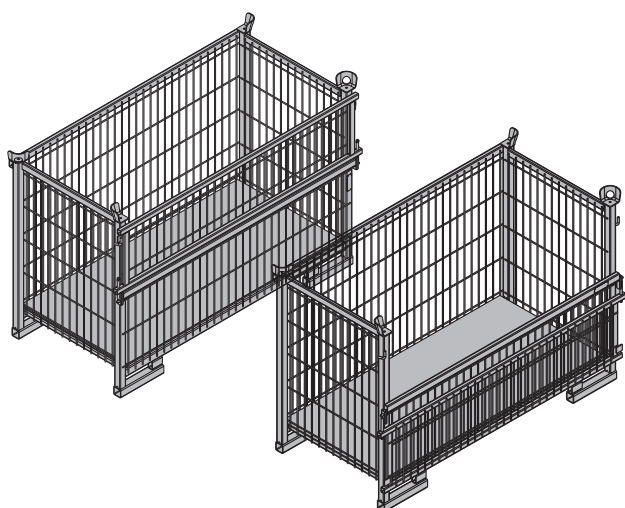
- The parts must be onloaded and off-loaded, transported and stacked in such a way that it is not possible for them to fall off, tip over or slide apart.
- Only set down the parts or assembly units on flat, firm, clean surfaces.
- Spread-angle β of slinging chains: max. 30°.
- Do not detach parts from the lifting straps until they have been safely set down.
- When transporting the equipment by truck, bundle the components or otherwise secure them against slippage, or else transport them in suitable containers.
- Protect all components against soiling, as this prolongs their service life.
- Clearly arranged, logical storage arrangements reduce the time needed for assembly.
- Using intermediate packing timbers during storage and transport lessens the risk of damage.

Please co-ordinate arrangements for return delivery of the equipment with the Doka branch responsible.

Utilise the benefits of Doka multi-trip packaging on your site.

Multi-trip packaging such as containers, stacking pallets and skeleton transport boxes keep everything in place on the site, minimise time wasted searching for parts, and streamline the storage and transport of system components, small items and accessories.

Doka skeleton transport box 1.70x0.80m



Storage and transport devices for small items:

- durable
- stackable

Suitable transport appliances:

- crane
- pallet stacking truck
- forklift truck

To make the "Doka skeleton transport box" easier to load and unload, one of its sidewalls can be opened.

Max. load: 700 kg

Permitted imposed load: 3150 kg



- Multi-trip packaging items that each contain very different loads must be stacked with the heaviest ones at the bottom and the lightest ones at the top!
- Rating plate must be in place and clearly legible

Using Doka skeleton transport boxes 1.70x0.80m as storage units

Max. n° of boxes on top of one another

Outdoors (on the site) Floor gradient up to 3%	Indoors Floor gradient up to 1%
2	5
It is not allowed to stack empty pallets on top of one another!	

Using Doka skeleton transport boxes 1.70x0.80m as transport devices

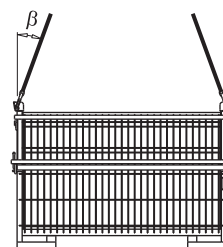
Lifting by crane



- ▶ Only lift the boxes when their sidewalls are closed!



- Multi-trip packaging items may only be lifted one at a time.
- Use a suitable lifting chain (e.g. Doka 4-part chain 3.20m). Do not exceed the permitted load-bearing capacity.
- Spread-angle β max. 30°!

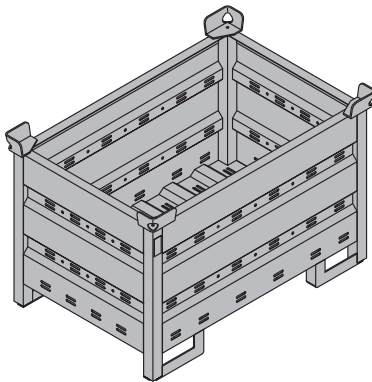


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Repositioning by forklift truck or pallet stacking truck

The forks can be inserted under either the broadside or the narrowside of the containers.

Doka multi-trip transport box 1.20x0.80m galv.



Storage and transport devices for small items:

- durable
- stackable

Suitable transport appliances:

- crane
- pallet stacking truck
- forklift truck

Max. load: 1500 kg

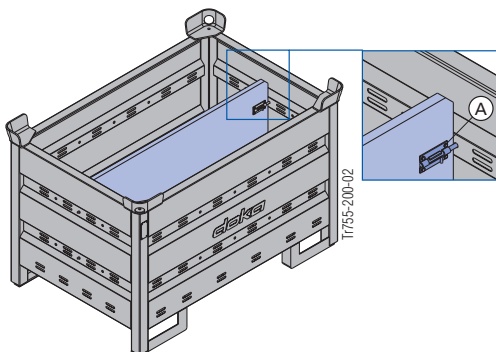
Permitted imposed load: 7900 kg



- Multi-trip packaging items that each contain very different loads must be stacked with the heaviest ones at the bottom and the lightest ones at the top!
- Rating plate must be in place and clearly legible

Multi-trip transport box partition

Different items in the Multi-trip transport box can be kept separate with the Multi-trip transport box partitions 1.20m or 0.80m.



A Slide-bolt for fixing the partition

Possible ways of dividing the box

Multi-trip transport box partition	Lengthways	Crossways
1.20m	max. 3 partitions	-
0.80m	-	max. 3 partitions
	Tr755-200-04	Tr755-200-05

Using Doka multi-trip transport boxes as storage units

Max. n° of boxes on top of one another

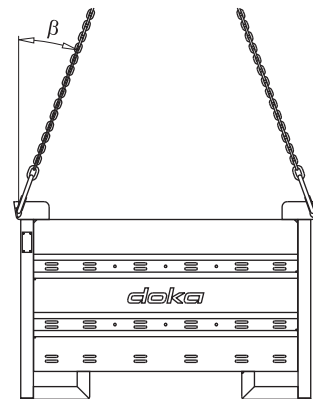
Outdoors (on the site) Floor gradient up to 3%	Indoors Floor gradient up to 1%
3	6
It is not allowed to stack empty pallets on top of one another!	

Using Doka multi-trip transport boxes as transport devices

Lifting by crane



- Multi-trip packaging items may only be lifted one at a time.
- Use a suitable lifting chain (e.g. Doka 4-part chain 3.20m). Do not exceed the permitted load-bearing capacity.
- Spread-angle β max. 30°!



9206-202-01

Repositioning by forklift truck or pallet stacking truck

The forks can be inserted under either the broadside or the narrowside of the containers.

Reshoring props, concrete technology and striking



Follow the directions in the Calculation Guide entitled 'Stripping out formwork from floors in building construction', and/or ask your Doka technician.

When is the best time to strip out the formwork?

The concrete strength needed before the formwork can be stripped out will depend upon the load factor α . This can be read off from the following table.

Load factor α

This is calculated by:

$$\alpha = \frac{OW_D + LL_{\text{construction state}}}{OW_D + OW_{\text{finishing}} + LL_{\text{final state}}}$$

Slab thickness 'd' [m]	Dead-weight load OW_D [kN/m ²]	Load factor α LL _{final state}			
		2.00 kN/m ²	3.00 kN/m ²	4.00 kN/m ²	5.00 kN/m ²
0.14	3.50	0.67	0.59	0.53	0.48
0.16	4.00	0.69	0.61	0.55	0.50
0.18	4.50	0.71	0.63	0.57	0.52
0.20	5.00	0.72	0.65	0.59	0.54
0.22	5.50	0.74	0.67	0.61	0.56
0.25	6.25	0.76	0.69	0.63	0.58
0.30	7.50	0.78	0.72	0.67	0.62
0.35	8.75	0.80	0.75	0.69	0.65

Valid for a finishing-load $OW_{\text{finishing}} = 2.00 \text{ kN/m}^2$ and a live load in the early-stripped state of $LL_{\text{construction state}} = 1.50 \text{ kN/m}^2$

OW_D : calculated with $\gamma_{\text{concrete}} = 25 \text{ kN/m}^3$

$OW_{\text{finishing}}$: load for floor finish, etc.

Example: Slab thickness 0.20 m with a final live load of 5.00 kN/m^2 results in a load factor α of 0.54.

This means that formwork removal / stress-release can take place once the concrete has reached 54% of its 28-day strength. The load-bearing capacity will then correspond to that of the finished structure.



Important note:

If the floor props are not stress-relieved, meaning that the slab has not been activated, then the props will remain loaded with the dead weight of the floor-slab.

When the floor above is concreted, this may lead to a doubling of the load that is being applied to the floor props.

The floor props are not designed to cope with such an overload, and the result may be damage to the formwork, the floor props and the structure.

Why put up reshoring props after stripping out the formwork?

After the formwork has been stripped out and the slab has been stress-relieved or deshored, the slab is able to bear its own weight and live loads resulting from the construction state, but not the concreting loads from subsequent floor-slabs.

The temporary reshoring serves to support the floor-slab and distribute the concreting loads across several floors.

Positioning the reshoring props correctly

Reshoring props have the job of spreading loads between the new floor-slab and the floor beneath it. This load distribution will depend on the relationship between the rigidities of these two floor-slabs.



Ask an expert!

As a rule, the question of using reshoring props should be referred to the responsible experts, regardless of the information given above.

Observe all local Standards and regulations!

Deflection of the new concrete

The modulus of elasticity of the concrete has already reached more than 90 % of the 28-day value after only 3 days, regardless of the formulation of the concrete. The increase in the elastic deformation taking place in the new concrete is thus only negligible.

The creep deformation, which only finally ceases after several years, is several times more than the elastic deformation.

Early stripping – e.g. after 3 days instead of 28 – thus only leads to an increase in the total deformation of less than 5 %.

The part of this deformation accounted for by creep deformation, however, may be anything between 50 % and 100 % of the standard value, due to such variable influences as the strength of the aggregates, and the atmospheric humidity. This means that the total deflection of the floor-slab is practically independent of the time at which the formwork was stripped out.

Cracks in new concrete

The bonding strength between the reinforcement steel and the concrete develops more rapidly in the new concrete than does its compressive strength. This means that early stripping does not have any negative influence upon the size and distribution of cracks on the tension side of reinforced concrete constructions.

Other cracking phenomena can be countered effectively by appropriate curing methods.

Curing of new concrete

New site-placed concrete is exposed to influences which may cause cracking and slow down its strength development:

- premature drying
- over-rapid cooling in the first few days
- excessively low temperatures or frost
- mechanical damage to the surface of the concrete
- hydration heat
- etc.

The simplest precaution is to leave the formwork on the concrete surface for longer. As well as the familiar extra curing measures, this measure should be carried out in any case.

Removing the load from the formwork from wide-spanned floor-slabs with support centres of over 7.5m

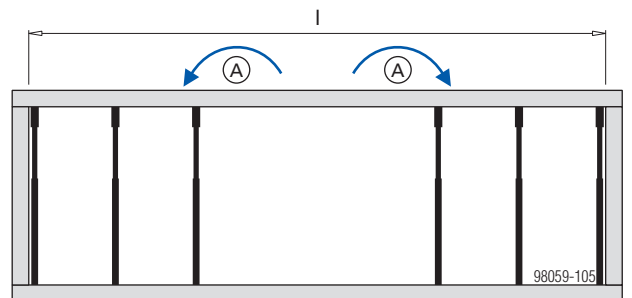
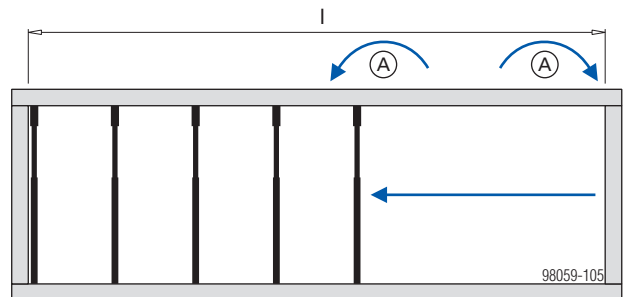
In the case of thin, wide-spanned concrete floor-slabs (e.g. in multistorey car parks), the following points must be remembered:

- When the load is taken off the floor props, the floor props that are still in place are briefly subjected to additional loads. This may lead to overloading, and to the floor props being damaged.
- Please consult your Doka technician.



The basic rule is:

- Stress-release should **always be carried out working from one side towards the other, or from the middle of the floor slab (mid-span) towards the slab-edges**.
For wide spans, this procedure **MUST** be followed!
- Stress-release must **NEVER** be carried out from both sides towards the middle!



l ... Effective floor-slab spans of 7.50 m and over

A Load redistribution

Weighted maturity method

This procedure for determining the strength of the concrete with reference to its maturity has been technically established for some 30 years now. Concremote uses the maturity determination method developed by de Vree. The weighted maturity is calculated as follows:

$$R_g = 10 \cdot \frac{[C^{(0.1T-1.245)} - C^{(-2.245)}]}{\ln C}$$

R_g ... weighted maturity per hour [C°h]

T ... mean hardening temperature of the concrete in one hour

C ... reactivity coefficient of the binding agent

To determine the maturity of the concrete, the weighted maturities per hour are cumulated. [1]

On the basis of the strength values from the calibration measurement, each maturity level has a particular compressive strength assigned to it.

This method for determining the concrete strength with reference to the maturity-level is addressed in the following technical documents and Standards:









- DBV Code of Practice, Concrete Formworks and Stripping Times, 2006 [2]
- DIN 1045-3, Concrete, reinforced and prestressed concrete structures – Part 3, 2008 [3]

Use and benefits

Based on the measured strength data, the Concremote concrete monitoring system allows you to assure, optimise and speed up your building process by taking the appropriate measures.

Concremote can be used for the following:

- Determining stripping times in a reliable and precise manner – cycle time optimisation – cycle time reduction
- Process reliability – decisions are based on measured rather than estimated values
- Determining curing times by means of the measured strength development
- Safety in using climbing formwork
- Measurement of the hydration heat development in structural mass elements
- Seasonal adjustment and optimisation of the concrete mixture based on the continuous measurement of the compressive strength development (e.g. slow strength development in the winter period – change of the concrete mixture for faster strength development)

	[kg]	Article n°		[kg]	Article n°
Concremote slab sensor Concremote-Deckensensor  Grey Height: 15.5 cm Diameter: 18.5 cm	1.3	583040000			
Concremote cable sensor Concremote-Kabelsensor  Grey Length: 26.3 cm	0.90	583041000			
Concremote wall sensing element Concremote-Messfühler Wand 	0.74	583042000			
Concremote cable, 1 sensor 0.60m Concremote cable, 1 sensor 1.50m Concremote-Kabel, 1 Messfühler 	0.05 0.08	583047000 583046000			
Concremote cable, 3 sensors 8.00m Concremote cable, 3 sensors 10.00m Concremote cable, 3 sensors special length Concremote-Kabel, 3 Messfühler 	0.21 0.25 0.25	583043000 583044000 583045000			
Concremote calibration box Concremote-Kalibrierbox  Aluminium Yellow Length: 102 cm Width: 36.2 cm Height: 36.8 cm	22.5	583049000			
Concremote battery set Concremote-Batterien-Set  Black	0.16	583048000			
Concremote transport box Concremote-Transportbox  Yellow Length: 40 cm Width: 40 cm Height: 24 cm	1.0	583050000			

Near to you, worldwide

Doka is one of the world leaders in developing, manufacturing and distributing formwork technology for use in all fields of the construction sector.

With more than 160 sales and logistics facilities in over 70 countries, the Doka Group has a highly efficient distribution network which ensures that equipment and

technical support are provided swiftly and professionally.

An enterprise forming part of the Umdasch Group, the Doka Group employs a worldwide workforce of more than 5600.

